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Case Report

Argentinian Flag Sign and Its Management during Femtosecond Laser-Assisted Cataract Surgery in a Case with Intumescent Cataracts

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Femtosecond laser-assisted cataract surgery · Capsulotomy · Radial extension · Argentenian flag · Cataract surgery · Complications

Abstract
We describe a case of radial extension and its management during femtosecond laser-assisted cataract surgery (FLACS) in a patient with intumescent cataracts. Radial extension was observed after injection of trypan blue into the anterior chamber. Management of the extension was achieved by separation of adhesions between the incomplete capsulotomy, along with manual completion at the areas of extensions. Careful observation during FLACS capsulotomy is advised in cases of intumescent cataracts due to the release of cortex into the anterior chamber which may interfere with the delivery of the laser treatment resulting in incomplete capsulotomy patterns. Furthermore, trypan blue staining is essential to identify possible incomplete capsulotomy patterns and extensions. The Argentinian flag sign may occur after femtosecond laser-assisted capsulotomy in cases of intumescent cataracts. Proper identification of incomplete capsulotomy patterns and radial extensions should be managed with careful manual completion of the capsulotomy.

Introduction

Radial extension of the capsulorhexis during the initiation of cataract surgery is a rare phenomenon and is more common in cases with intumescent cataracts (pressurized capsular bags) [1]. This sign is observed during cataract surgery after puncture of the anterior lens capsule during initiation of the capsulorrhexis [1]. The pathophysiologic mechanism is attributed to a highly pressurized lens system; the incompletely liquefied cortex of the crystalline lens

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remains attached at the equator of the lens forming 2 separate anterior and posterior pressures within the capsule. When puncturing the anterior capsule (causing a decrease in pressure of the anterior capsular chamber), the remaining posterior pressure causes anterior displacement of the lens and subsequent strain on the anterior capsule, leading to radial extension of the capsular tear [1]. The term "Argentinian flag sign" is used to describe this condition due to its resemblance of the blue-white-blue Argentinian flag color pattern after capsular staining with trypan blue [1].

Several techniques have been used to prevent the radial extension of capsular tears when a surgeon anticipates a pressurized capsule [2–6]. Lately, femtosecond lasers have been used to facilitate cataract extraction, femtosecond laser-assisted capsulotomy is another approach used to prevent extension of capsular tears [7]. The ultrafast pulses of photodisruption in a circular pattern along with the pressure release over a larger surface, when compared to manual puncture, make radial extension less likely. In this case report, we present a case of radial extention and its management of a capsulotomy after femtosecond laser-assisted capsulotomy.

Case Report

A 58-year-old female patient presented to our institute complaining of progressively decreased vision in the right eye. The patient had no prior ocular history and her uncorrected distance visual acuity at presentation was LP and 20/70 in her right and left eye respectively; while her corrected distance visual acuity was LP (no improvement) and 20/50, respectively. Slit lamp examination revealed the presence of a white intumescent cataract in the right eye, as well as nuclear, cortical, and posterior subcapsular cataract in the left eye. A B-scan of the right eye was performed, revealing no retinal pathology or retinal detachment. The patient was informed of the risks and benefits of cataract surgery and, after obtaining informed consent, was scheduled to undergo femtosecond laser-assisted cataract surgery (FLACS) targeting plano in both eyes; the patient also provided a signed written consent allowing for publication/presentation of personal medical information.

The femtosecond laser was programmed for capsulotomy, fragmentation, and arcuate keratomies, and the procedure was performed using the LenSx laser platform (Alcon, Fort Worth, TX, USA). The capsulotomy parameters used in this case were a diameter of 5.5 mm, a treatment height of 0.625 mm, energy of 6.0 μJ, tangential spot separation of 5 μm, and a layer separation of 5 μm. The lens parameters used in this case were an energy of 8 μJ, a cube fragmentation pattern with spot separation of 20 μm, and layer separation of 50 μm. During the capsulotomy of the right eye, a plume of cortex was noted to rise into the anterior chamber. Once the laser-assisted portion of the procedure was completed, the patient was brought into the operating room, trypan blue was instilled, and it was noted that the capsulotomy was incomplete with attachments at 6:00 and 11:00 with radial extensions at 4:00 and 11:00 (Fig. 1).

Capsulotomy forceps were utilized to free the capsulotomy edges and redirect the radial extension. The remainder of the cataract surgery was uneventful and a monofocal IOL was inserted in the capsular bag (Fig. 2). The patients uncorrected distance visual acuity was 20/400, 20/20-2, and 20/25+ on day one, week 1, and week 2, respectively.

Discussion

Several techniques have been used to prevent the radial extension of capsular tears "Argentinian Flag" when a surgeon anticipates a pressurized capsule [2–6]: (1) utilizing a 27-gauge needle on a syringe through the anterior capsule to aspirate liquefied cortex

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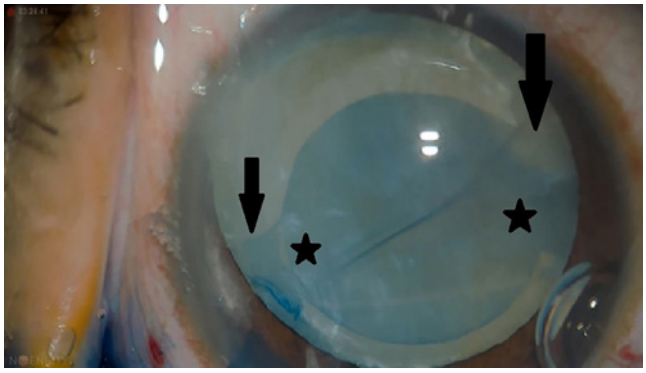

Fig. 1. Intraoperative image after trypan blue injection in the anterior chamber. The femtosecond laser-assisted capsulotomy appears to be incomplete with 2 areas of adhesions (stars) and 2 radial extensions (arrows).

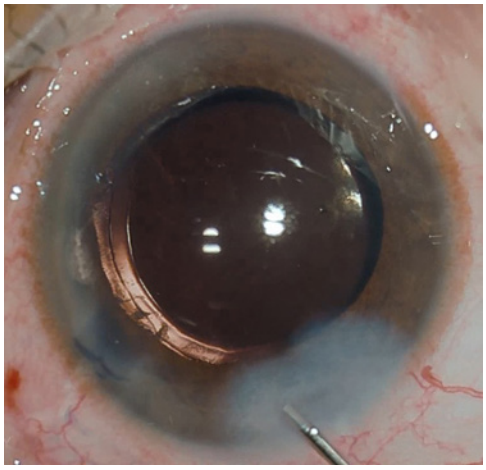

Fig. 2. Intraoperative image after successful implantation of the intraocular lens in the capsular bag.

[2]. (2) Instilling a highly cohesive viscoelastic to maintain a deep anterior chamber and counter pressure [3]. (3) Utilizing a phocoemulsification tip on an intact anterior capsule to aspirate liquified cortex and a portion of the lens while simultaneously depressurizing the compartment [4]. (4) Creating a two-stage continuous curvilinear capsulorhexis or a "snail track" capslulorhexis. This consists of keeping the initial rhexis small and enlarging circumferentially [5, 6]. (5) 250 mL of IV mannitol can be given 60 min prior to surgery to equalize AC pressure [4, 6]. (6) Another approach to avoid radial extension using femtosecond laser-assisted capsulotomy creation in cases with intumescent cataracts has been described by Schultz and Dick [8], as a 2-step "mini-capsulotomy." The technique involves creating a mini-capsulotomy to release lens pressure, then removing the cortical fluid from the anterior chamber prior to re-docking the laser to create a larger capsulotomy.

Femtosecond lasers use a process called photodisruption, which achieves disruption of cellular bonds, creating plasma gas; this produced gas causes tissue separation when it expands (cavitation). Femtosecond lasers have been used in assisting cataract surgery since 2009 [8] to create capsulotomies, crystalline lens fragmentation, and corneal incisions. Unlike the manual capsulorhexis when the edge of the rhexis is smooth, the capsular edges of femtosecond laser-created capsulotomies contain micro-irregularities of varying patterns resembling "postage stamp-like" perforations [3]. Due to the organized circular nature of these microperforations, radial tear outs are less likely to extend beyond the circular pattern into the periphery; however, the complication can still occur, especially in highly pressurized intumescent cataracts.

It is important to carefully observe for signs of increased intracapsular pressure preoperatively as in the case presented herein (intumescent cataract) and to anticipate possible radial extensions. Furthermore, during FLACS capsulotomies, the surgeon should observe for signs that may lead to incomplete capsulotomy patterns such as cortex in the anterior chamber or absence of "champagne bubble" gas release 360° surrounding the capsulotomy. Anything that causes interference with anterior segment imaging during FLACS can disrupt laser delivery resulting in an incomplete capsulotomy. It is advisable that a surgeon anticipate and prepare for this problem through the use of trypan blue, checking the capsule for adhesions and incomplete patterns, avoiding over pressurizing the eye, and being ready to manually intervene to manage possible radial extensions. Surgeons may also utilize the 2-step mini-capsulotomy procedure described by Schultz and Dick [8], which may overcome possible radial extensions in cases with intumenscent cataracts.

Overall, the ability of femtosecond lasers to create consistent and smooth capsulotomies has greatly improved, thus increasing the integrity of laser-created capsulotomies. Manual capsulorhexis do not contain the micro-irregularities seen in femtosecond laser-created capsulotomies; however, the femtosecond laser-created capsulotomy has less chance to extend radially due to the speed at which the laser delineates in a circular pattern. The Argentinian flag sign was present in our case but to a minimal extent, and our capsulotomy was saved with minor radial extension.

In conclusion, the Argentinian flag sign may occur during FLACS-assisted capsulotomy creation. Surgeons must be prepared to identify and manage this phenomenon.

Statement of Ethics

This report does not contain any personal identifying information of the patient.

Conflict of Interest Statement

Dr. Weinstock is a consultant for Alcon Laboratories, Inc. None of the other authors (Maria Adams and Vasilios F Diakonis) have a financial or proprietary interest in any material or methods mentioned.

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Author Contributions

All authors attest that they meet the current ICMJE criteria for authorship.

Patient Consent

The patient provided a signed written consent allowing for publication/presentation of personal medical information.

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